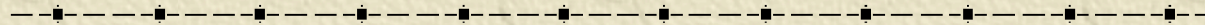




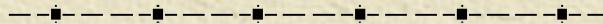
Bold Endeavors

Risk and Exploration: Earth, Sea, and the Stars

September 27 – 29, 2004



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Anacapa Sciences, Inc.
Santa Barbara, California



Risk and Exploration



H.M.S. Endeavor, on which Captain James Cook made his first voyage.

✦ Why Nations Explore

- ✦ Trade Routes
- ✦ Resources
- ✦ Prestige
- ✦ Science

✦ Why People Explore

- ✦ Achievement
- ✦ Curiosity
- ✦ Risk ?

Risk and Exploration

✦ Critics of exploration have always postulated insurmountable obstacles to bold endeavors.

“People, perhaps, still exist who believe that it is of no importance to explore the unknown polar regions. This, of course, shows ignorance... The history of the human race is a continual struggle from darkness toward light. It is, therefore, to no purpose to discuss the use of knowledge; man wants to know, and when he ceases to do so, he is no longer man.” - Fridtjof Nansen



Risk and Exploration

“Little minds have only room for thoughts of bread and butter.”
- Roald Amundsen

“Not a single article of the outfit had been tested; and amid the general ignorance that prevailed the lack of system was painfully apparent in everything.”
- Robert Falcon Scott (1904)

“We took risks, we knew we took them; things have come out against us, and therefore we have no cause for complaint.”
- Robert Falcon Scott (1912)



Risk and Exploration

“The members of this expedition believed that it was worth while to discover new land and new life, to reach the South Pole of the Earth, to make elaborate meteorological and magnetic observations and extended geological surveys with all the other branches of research for which we were equipped. They were prepared to suffer great hardship; and some of them died for their beliefs.”

- Apsley Cherry-Garrard

Isolation and Confinement



“All the conditions necessary for murder are met if you shut two men in a cabin measuring 18 feet by 20 and leave them together for two months.”

- Valery Ryumin

- ✦ Imagine living in a motor home with five other people for three years.
- ✦ You may go outside for a few hours at a time *only* during the second year, but you must wear a space suit.
- ✦ You are a very long way from home (and the nearest store, gas station, TV, friend - everything).
- ✦ An expedition to Mars would be a lot like this.

Isolation and Confinement



Isolation and Confinement



Skylab



Amundsen-Scott South Pole Station

Learning From Previous Expeditions



Expeditions and polar winter-over experiences resemble in many ways the conditions of isolation and confinement that will be experienced by future space travelers and those who will live and work at lunar and Martian outposts.

Jules Sebastien-César Dumont d'Urville

- ✧ Venus di Milo
- ✧ *Astrolabe* 1826-1829
- ✧ *Astrolabe & Zelee*
1837 - 1840
- ✧ Linguist / Scientist
- ✧ Leadership Skills
- ✧ Habitability



Jules Sebastien-César Dumont d'Urville



The corvettes *Astrolabe* and *Zelee* in Antarctica, 9 February 1838,
by Louis Lebreton, assistant surgeon onboard the *Astrolabe*.

Lewis and Clark Expedition



- ✧ Corps of Discovery
- ✧ 40 Explorers
- ✧ 1804 – 1806 (28 months)
- ✧ Met Many Native People During the Journey
- ✧ Described Everything in Their Journals

Lewis and Clark Expedition



Lewis and Clark Expedition

✧ Lessons for Moon and Mars Exploration

- ◆ Leadership
- ◆ Planning
- ◆ Cooperation
- ◆ Perseverance
- ◆ “Live Off the Land”
- ◆ The *Corps of Discovery*



British Surveying Expedition

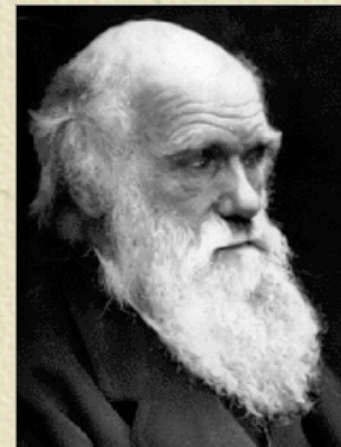


✧ Robert FitzRoy

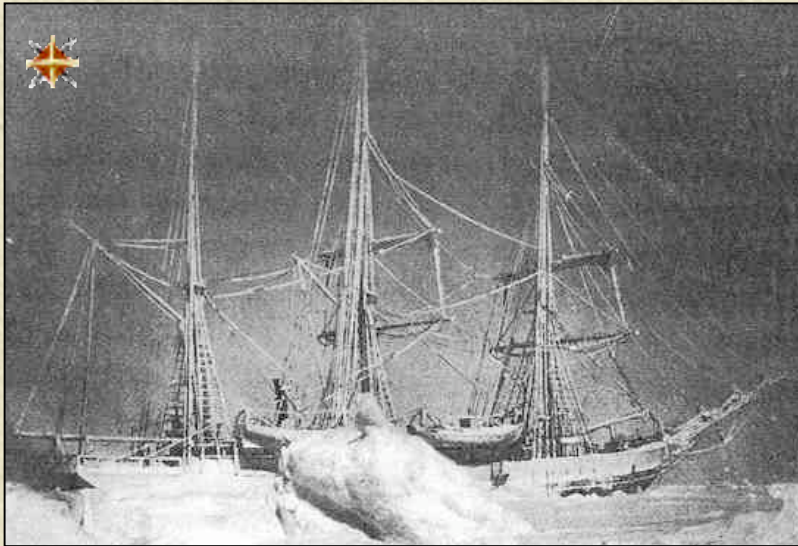
✧ Voyage of the *Beagle*

✧ 1831-1836

✧ Charles Darwin



Belgian Antarctic Expedition



The *Belgica* Locked in the Ice

- ✠ Commandant
Adrien de Gerlache
- ✠ 1898-1899
- ✠ First Expedition to
Winter-Over in
Antarctica
- ✠ Multi-National Crew

“Insanity and disease stalked the decks of the *Belgica* that winter.”
- Roald Amundsen

Belgian Antarctic Expedition

Frederick A. Cook, Expedition Physician



Before



After

Australasian Antarctic Expedition



✧ Douglas Mawson

✧ *Aurora*

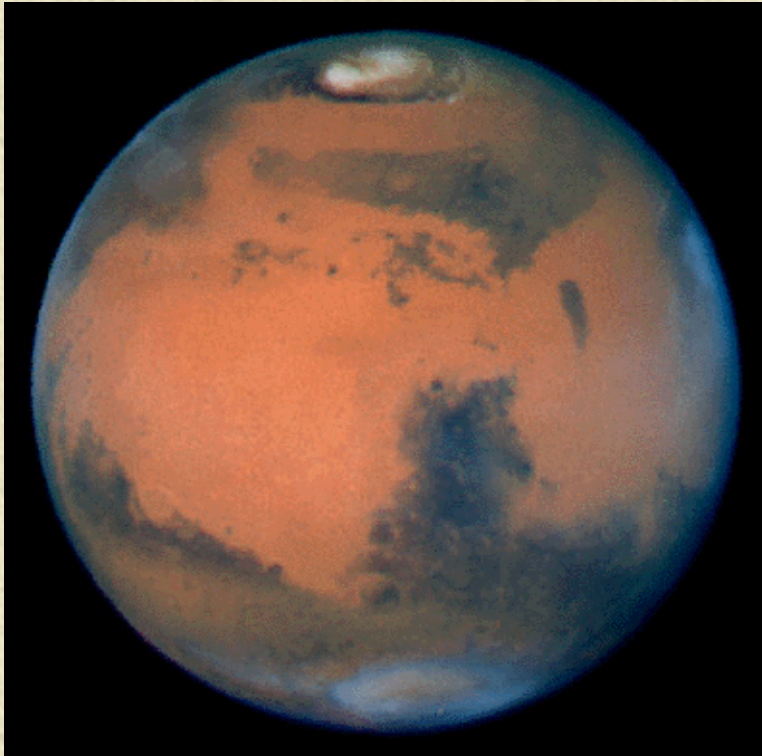
✧ 1911-1914

“In no department can a leader spend time more profitably than in the selection of the men who are to accomplish the work.”

Weather influences everything. “To us, instead of being a mere prelude to more serious matters, or the last resort of a feeble intellect, it was the all-engrossing theme.”

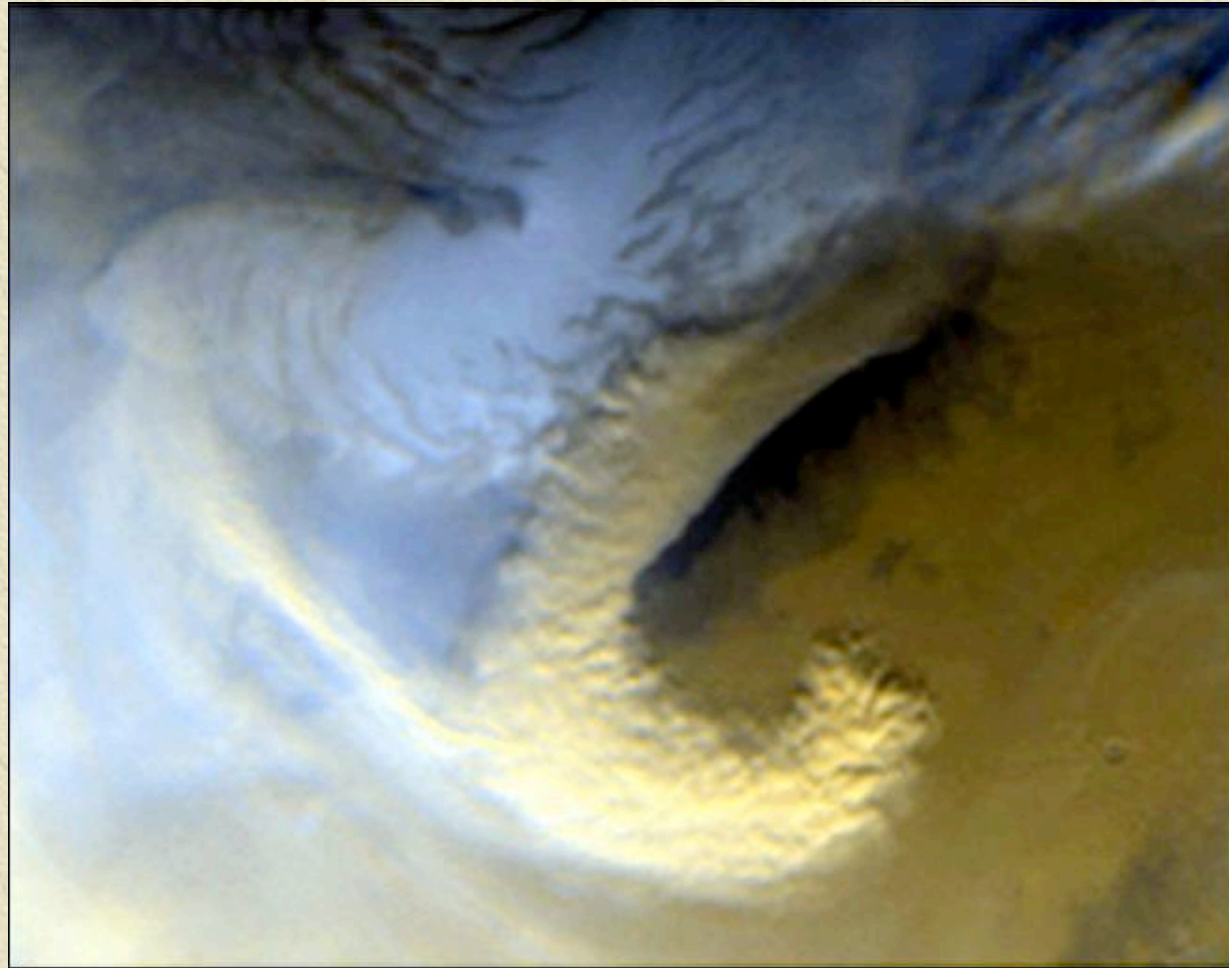
- Douglas Mawson

Martian Weather



- ✧ Galactic Cosmic Rays
 - ✧ Local (5 to 14 sols)
 - ✧ Regional (5 to 14 sols)
 - ✧ Global (60 to 80 sols)
- ✧ Solar Particle Events
- ✧ Dust Storms

Martian Weather



MSSS / NASA

Roald Amundsen



- ✧ Mate on the *Belgica*
- ✧ Northwest Passage
- ✧ South Pole
- ✧ *Norge*
- ✧ Dorneirs
- ✧ Nobile Rescue

Roald Amundsen

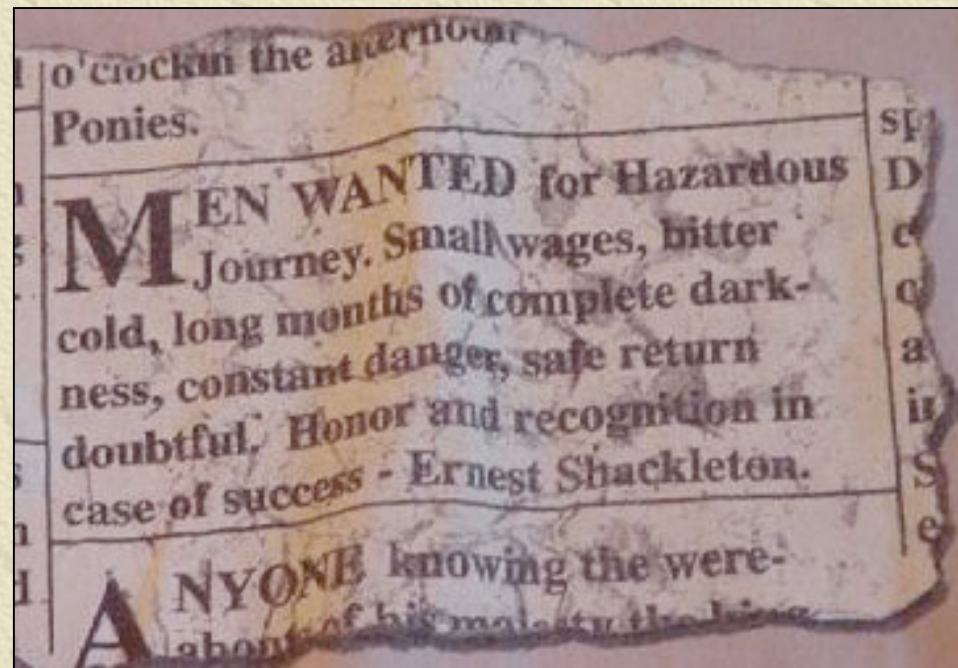
“The human factor is three quarters of any expedition.”

— Roald Amundsen



Ernest Shackleton

British Trans-Antarctic Expedition, 1914-1916



Shackleton's Recruiting Advertisement

Ernest Shackleton

British Trans-Antarctic Expedition, 1914-1916



The *Endurance* in the ice



Shackleton and Crew at Patience Camp

Ernest Shackleton

British Trans-Antarctic Expedition, 1914-1916



Castaways on Elephant Island



Launching the *James Caird*

Ernest Shackleton



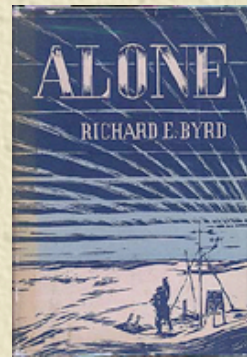
“For scientific leadership give me Scott; for swift and efficient travel, Amundsen; but when you are in a hopeless situation, when there seems no way out, get down on your knees and pray for Shackleton.”

Richard E. Byrd

Byrd's Expedition to Little America, 1933-1935



Life at Little America



Byrd at Advance Base

“Time was no longer like a river running, but a deep still pool.”

– Richard E. Byrd

Norwegian Polar Expedition



- ✧ Fridtjof Nansen
- ✧ 1893-1896
- ✧ Theory of Polar Drift
- ✧ 13 Norwegians
- ✧ Egalitarian Approach
- ✧ Good Habitat Design
- ✧ Methodical Testing
- ✧ A Model for Future Space Expeditions

Norwegian Polar Expedition



Departure of the *Fram*

Norwegian Polar Expedition



The *Fram* En Route



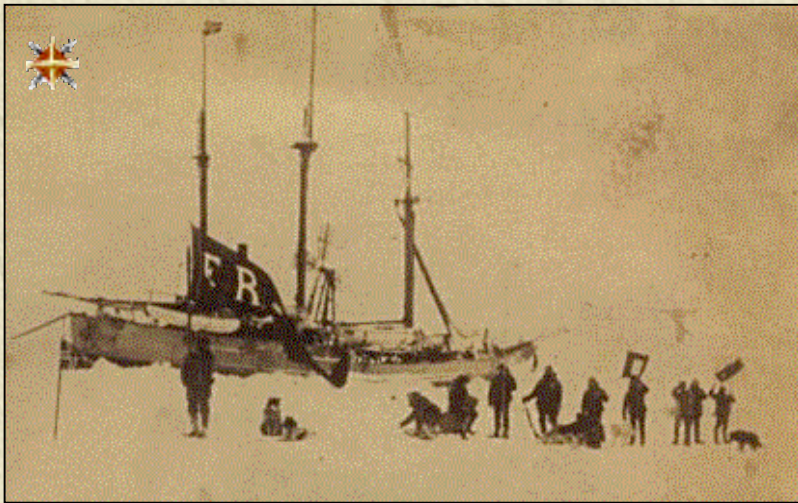
The *Fram* Above the Ice

Norwegian Polar Expedition



Conducting Research During the Expedition

Norwegian Polar Expedition



Life Onboard the *Fram*

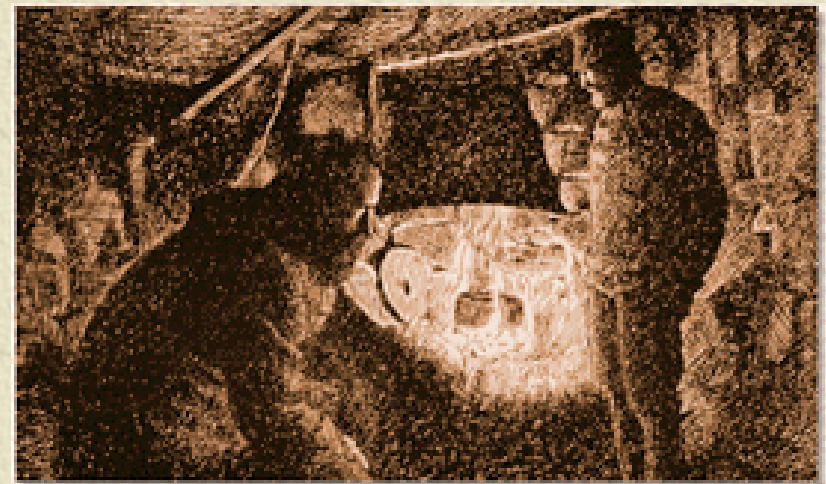
“Truly, the whole secret lies in arranging things sensibly, and especially in being careful about the food.”

- Fridtjof Nansen

Norwegian Polar Expedition



Entrance to the Hut



Life in Our Hut, by Fridtjof Nansen

Nansen and Johansen lived for nine months in a 6-foot by 10-foot hut made of stones and walrus hides.

Norwegian Polar Expedition



Nansen and Johansen in the Kayaks



Nansen After Meeting Jackson

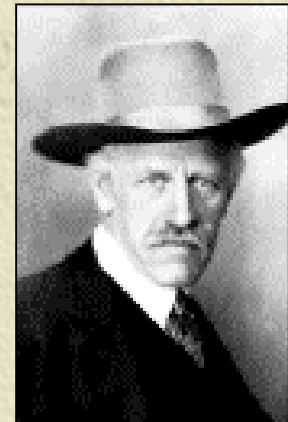
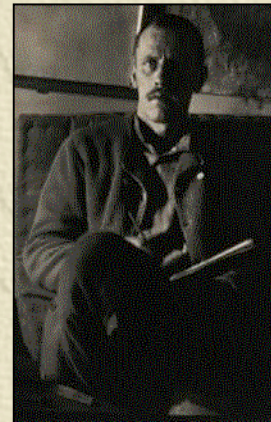
Norwegian Polar Expedition



Nansen and the crew of the *Fram* were greeted as if they had just returned from another planet.

Fridtjof Nansen

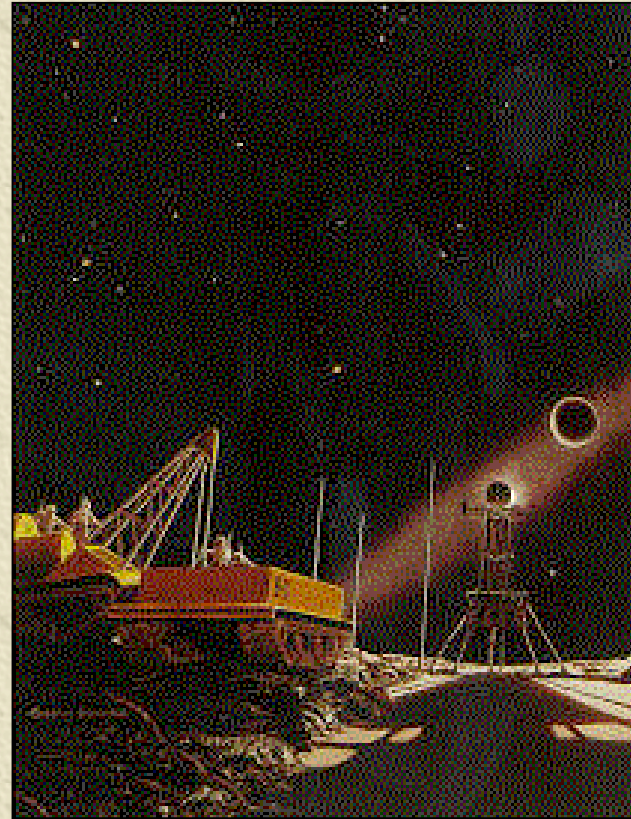
- ✧ Artist
- ✧ Explorer
- ✧ Neurologist
- ✧ Oceanographer
- ✧ Champion Skier
- ✧ A Founder of Norway
- ✧ International Statesman
- ✧ Recipient of the Nobel Peace Prize



Previous and Future Expeditions



The *Fram* in the Ice
By William Gilkerson



Lunar Expedition
By Chesley Bonestell

Main Themes

- ✦ There are highly predictable behavioral responses to isolation and confinement.
- ✦ Minor problems are common, but serious problems are avoidable.
- ✦ Future space expeditions will more closely resemble sea voyages than the test flights that presently serve as models.

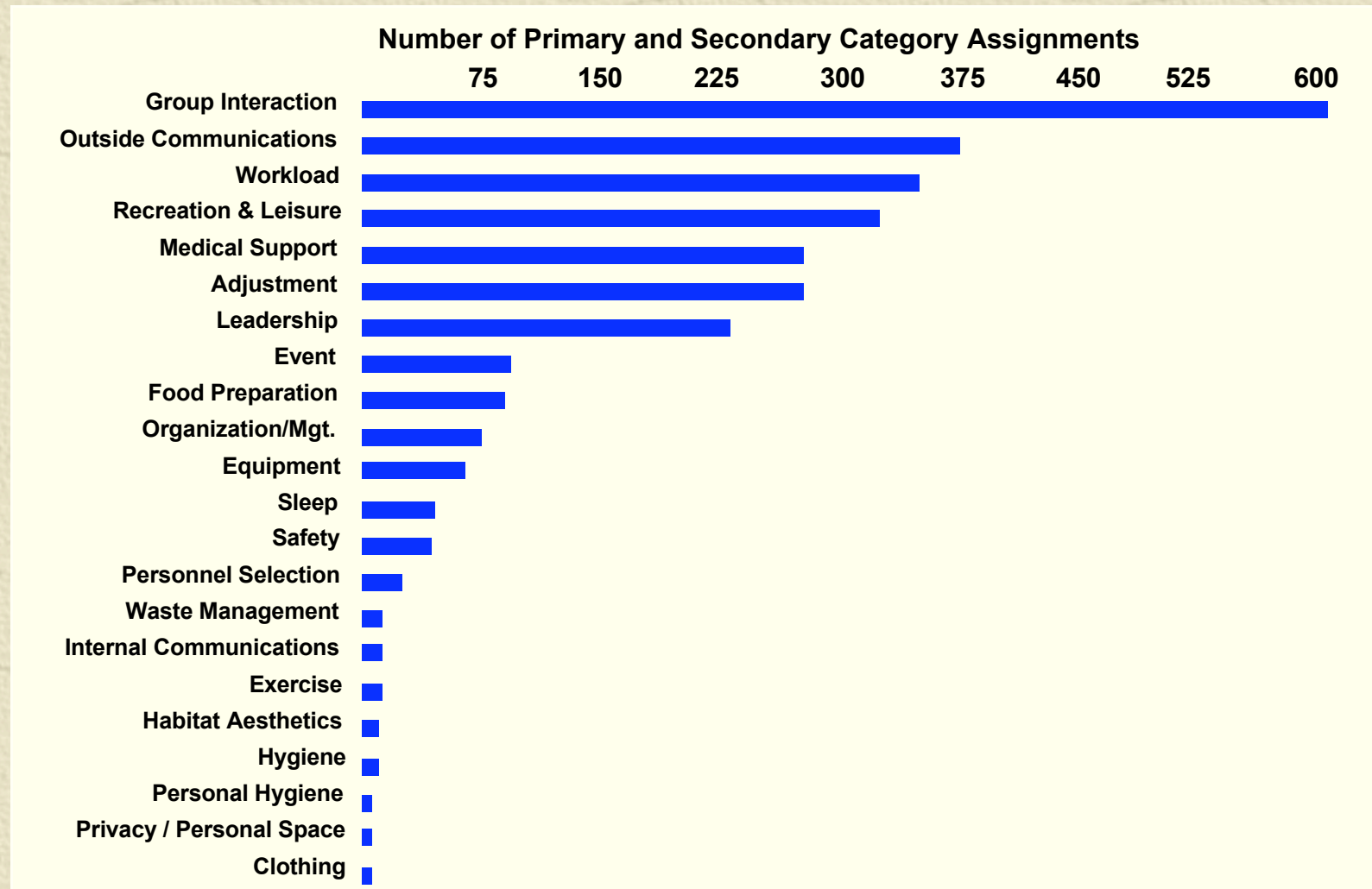
Main Themes

- ✦ Important lessons concerning the design and conduct of future expeditions can be learned by studying the experiences of remote duty personnel and previous explorers.
- ✦ Humans can endure almost anything.

Behavioral / Human Factors Issues



Current Research: Content Analysis of Diaries



Content Analysis: 3rd Quarter Phenomenon

Figure 1. Overall:
Long vs Short Duration and
All Missions Combined

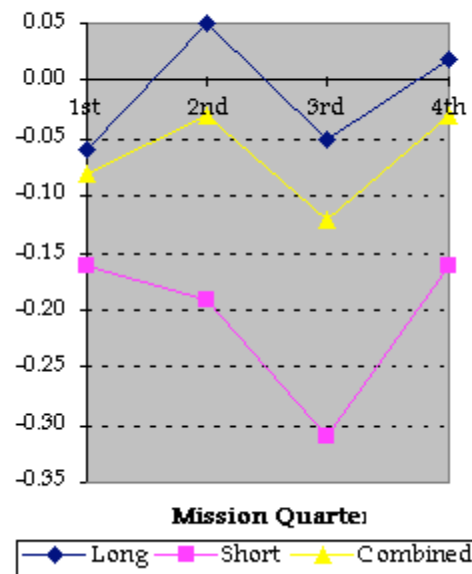
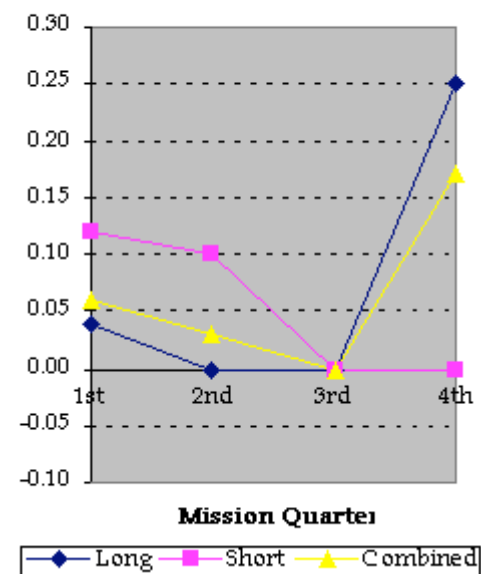


Figure 2. Group Interaction:
Long vs Short Duration and
All Missions Combined



Specific Lessons

- ✦ Establish a “spirit of the expedition.”
- ✦ Select qualified and compatible personnel.
- ✦ Test, train, and simulate everything.
- ✦ Provide good habitability & satisfying food.
- ✦ Remain busy and entertained.
- ✦ Realize that good leadership can be more important than good habitability.

Specific Lessons

- ✦ Expect that problems will occur (behavioral, communications, equipment).
- ✦ Expect weather to affect everything.
- ✦ Be prepared for casualties.
- ✦ Distribute stowage of supplies/equipment.
- ✦ “Live off the land” to the extent possible.
- ✦ Design for redundancy *and* maintainability.

Most Important

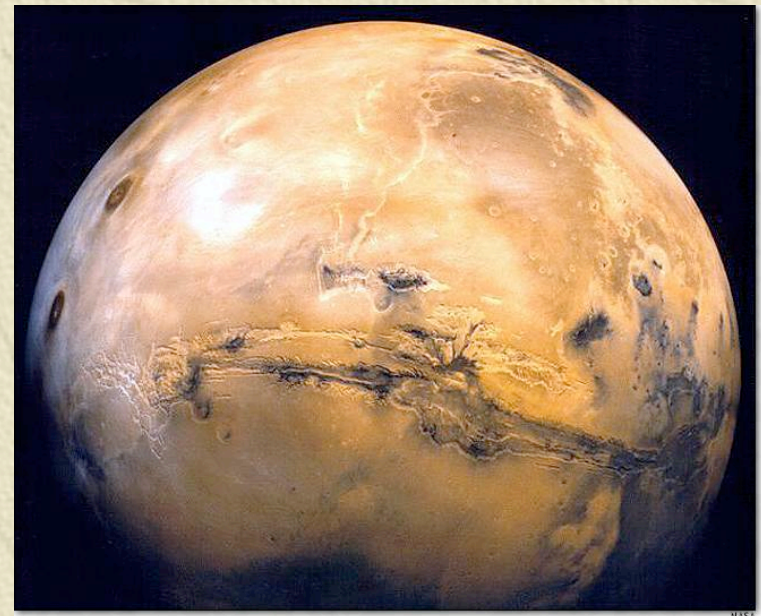


The conditions will be different, but most of the problems that will confront future space explorers are the same problems that troubled explorers in the past.

A New Age of Discovery



The Moon from the ISS

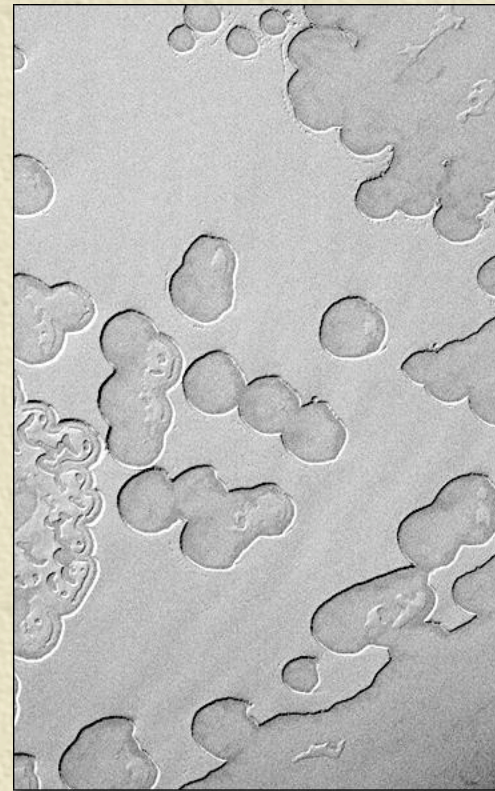


Mars from Orbit

A New Age of Discovery



Dunes

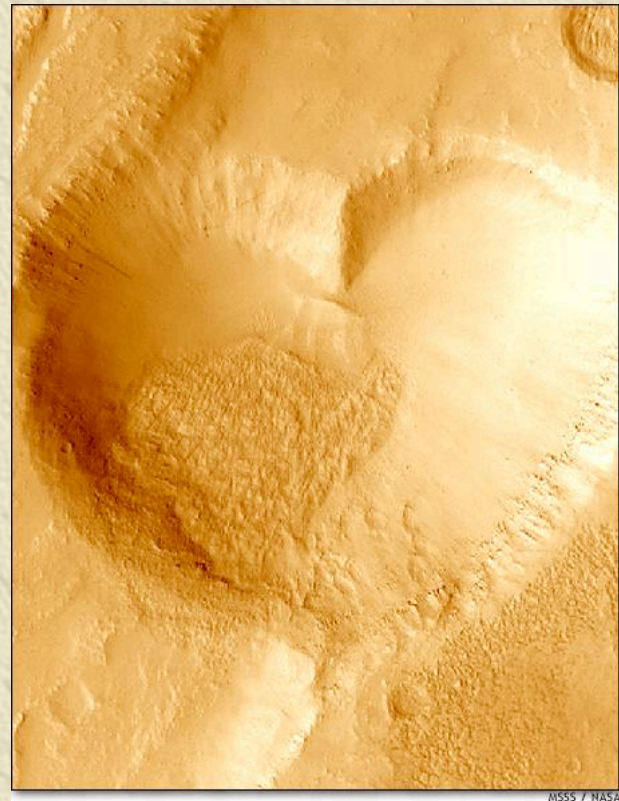


Frost

A New Age of Discovery



Galle Crater



Graben

A New Age of Discovery



Twin Peaks

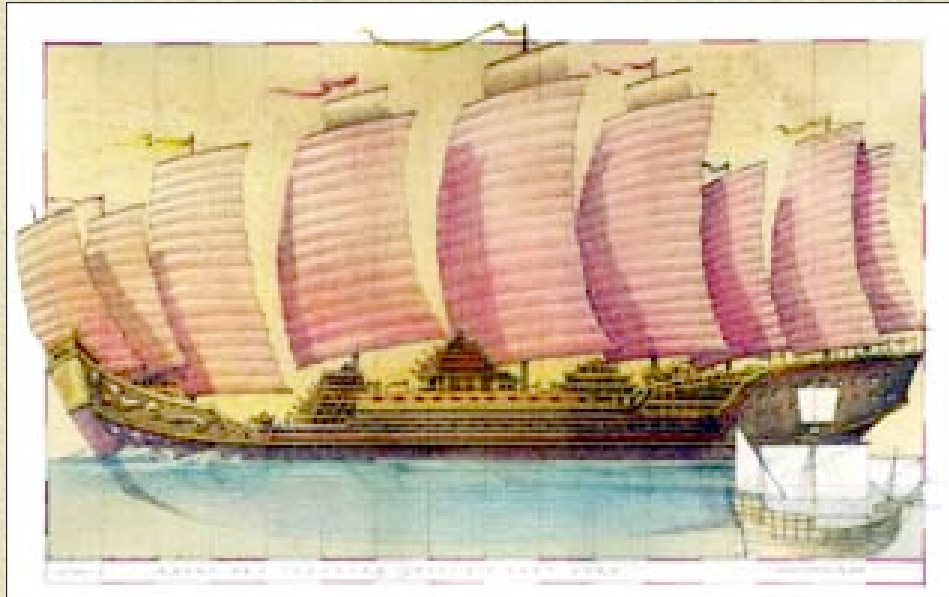
A Prediction

"Every age has its dreams, its symbols of romance. Past generations were moved by the graceful power of the great windjammers, by the distant whistle of locomotives pounding through the night, by the caravans leaving on the Golden Road to Samarkand, by quinquereemes of Nineveh from distant Ophir... Our grandchildren will likewise have their inspiration--among the equatorial stars. They will be able to look up at the night sky and watch the stately procession of the Ports of Earth--the strange new harbors where the ships of space make their planetfalls and their departures."

- Arthur C. Clarke



Risk and Exploration



Admiral Zeng He's Flagship (1433)

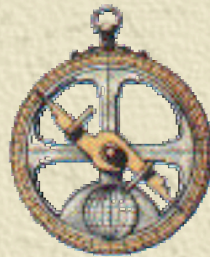
“There are risks and costs to a program of action. But they are far less than the long-range risks and costs of comfortable inaction.”

- John F. Kennedy

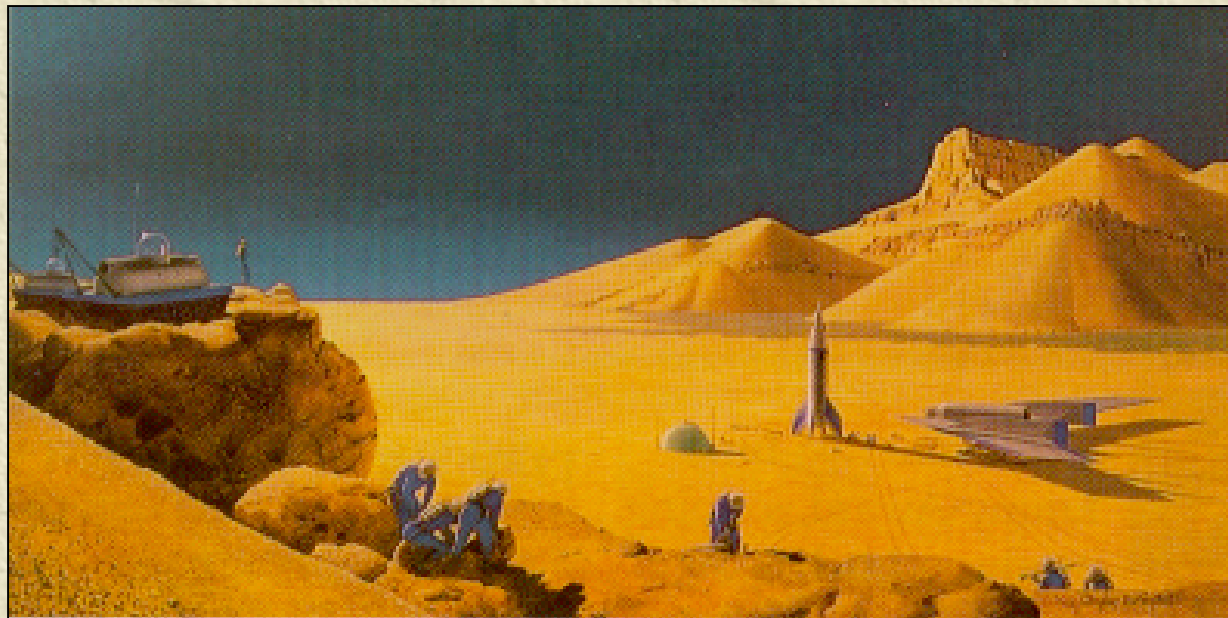
Risk and Exploration

“Twenty years from now you will be more disappointed by the things you didn’t do than by the ones you did. So throw off the bowlines. Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream. Discover.”

- Mark Twain



The Future...



Exploring Mars
By Chesley Bonestell, 1956